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**ENGINEERING SERVICE CENTER**
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# METHOD OF TEST FOR PROPORTIONS OF COARSE AGGREGATE IN FRESH CONCRETE

**CAUTION:** Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "SAFETY AND HEALTH" in Section H of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

## A. SCOPE

This test method is used to measure the proportion, by mass or volume, of coarse aggregate in fresh portland cement concrete. The test result may be used to determine compliance with Section 90 of the Standard Specifications. If tests are performed on separate portions of a batch, the results furnish a measure of the effectiveness of mixing. An Approximate Test Method and a Referee Test Method are described.

In the approximate test method, the density of the fresh concrete is assumed. Test results (CT 518) from other batches of concrete should be used as the basis for the assumption. The referee method requires measurement of the density of the sample being tested. The Approximate Test Method uses the damp drained mass of the aggregate as an approximation of the SSD mass. The Referee Test Method aggregate is brought to SSD. In both methods the bulk specific gravity (CT 206) must be known if the volume of the coarse aggregate is desired.

## B. APPARATUS

For the Approximate Test Method, the following equipment is needed:

1. Scales: Capacity of 50 kg, sensitivity to .01 kg
2. 4.75 mm or 19.0 mm sieve, brass, full height, 300 mm in diameter, for wet sieving fresh concrete. A rigid type handle may be attached to facilitate washing. The sieve to be used depends on the test information wanted.
3. Three wash tubs or large buckets in which to submerge sieve-containing concrete in water while wet sieving. Use of hose and running water may be substituted.
4. Small scoop.
5. Dishpans: 22.7 liters or other containers to sample concrete and use for weighing washed concrete aggregate. Tared mass should be established for each weighing container before starting any test.

The following additional equipment is needed to perform the Referee Test Method:

6. Approximately 1 $m^2$ absorptive fabric for surface drying coarse aggregate.
7. Measure: A cylindrical, watertight, steel measure having a minimum volume of 0.012 $m^3$, provided with handles. It shall have an inside diameter of about 250 mm and an inside depth of about 280 mm. It shall be constructed of No. 10 to No. 12 U.S. gage steel and shall be reinforced around the top with a steel band of the same gage, 38 mm wide.

8. Tamping rod: A round, straight, steel rod, 15 ± 1 mm diameter and approximately 600 mm long, having one end rounded to a hemispherical tip, the diameter of which is the same as the rod.

9. Glass cover plate, approximately 300 mm square, at least 5 mm thick and wire-reinforced, or acrylic plastic at least 6 mm thick.

NOTE: Items 1, 7, 8, and 9 are part of the test equipment used for California Test 518, Method of Test for Unit Mass, Volume and Cement Factor of Concrete, and are available as a unit from the Office of Purchasing and Warehousing.

## C. TEST REPORT FORM

No specific form is provided for reporting results.

## D. TEST PROCEDURE FOR APPROXIMATE TEST METHOD

1. a. Assume the unit weight of the fresh concrete based on any available test data. The bulk specific gravity, saturated, surface-dry (SSD) of the coarse aggregate must be known in order to calculate the absolute volume of coarse aggregate.

   b. Obtain a sample of concrete representative of the *portion* of the batch to be tested. The mass of the sample must be at least 45 kg.

2. Weigh out 35 ± 1 kg of the sample into a container for wet sieving.

3. a. Using scoop, place small quantities of concrete from the 35 kg sample into the chosen sieve (19 mm or 4.75 mm). Immerse the sieve in water and agitate it with a rotary motion while, at the same time, raising and lowering the sieve beneath the surface of the water. In lieu of the immersion method, material may be washed through a 4.75 mm sieve by using a hose, if running water is available.

   b. During the sieve operation, transfer the sieve to fresh containers of water twice, the last transfer being made after sieving is nearly completed.

   c. Continue sieving until it is evident that all undersize material has been removed. Take care not to spill any of the sample out of the sieve while wet sieving the submerged sample.

   d. Dump washed retained aggregate into a clean pan.

   e. Repeat operations until all of the sample has been wet sieved.

   f. After sample has been wet sieved and transferred to a clean weighing container, allow water to drain from aggregate for three minutes.

4. Drain off free water and weigh to nearest 0.01 kg.

5. Calculate the approximate mass or absolute volume of coarse aggregate per $m^3$ of concrete. Use of the following formulas:

$$W_A = (a/b) \times c \quad (1)$$

$$V_A = (a/b) \times c / G \quad (2)$$

Where:

$W_A$ = approximate mass in kg of coarse aggregate per $m^3$ of concrete.

$a$ = assumed density of the concrete in $kg/m^3$.

$b$ = the total mass of sample before sieving (35 kg $\pm$ 1).

$c$ = mass in kg of coarse aggregate retained on 4.75 mm (or 19 mm) sieve deter-mined by test of 35 kg sample.

$V_A$ = approximate absolute volume in $m^3$ of coarse aggregate per $m^3$.

$G$ = Bulk specific gravity (SSD) of coarse aggregate.

## E. TEST PROCEDURE FOR REFEREE TEST METHOD

1. Obtain a sample of concrete representative of the *portion* of the batch to be tested. The mass of the sample must be at least 45 kg.

2. Determine the actual density of the fresh concrete in accordance with California Test 518. Use the measure specified for 37.5 mm maximum size aggregate even if the specified aggregate is smaller.

3. Wet sieve the sample from the 0.015 $m^3$ measure as described in D, Test Procedure for Approximate Test Method, Sections 2 and 3.

4. Place the coarse aggregate on canvas or other absorbent material. Roll or stir the aggregate until surface moisture just starts to leave in order to bring aggregate to required saturated, surface dry (SSD) condition. Weigh immediately to nearest .01 kg.

5. Calculate mass or absolute volume of coarse aggregate per cubic foot of concrete by the following formulas:

$$W = (u/d) \times e \qquad (3)$$

$$V = (u/d) \times e/G \qquad (4)$$

Where:

$W$ = SSD mass in kg of coarse aggregate per $m^3$ of concrete.

$u$ = density in $kg/m^3$ of fresh concrete as determined by California Test 518.

$d$ = mass in kg of sample of concrete placed in the density measure.

$e$ = mass in kg of saturated, surface dry aggregate retained on sieve as deter-mined by test of sample from the density test.

and

$V$ = Absolute volume in $m^3$ of coarse aggregate per $m^3$ of concrete.

$G$ = Bulk specific gravity (SSD) of coarse aggregate.

## F. TEST PROCEDURE FOR ALTERNATE REFEREE TEST METHOD

1. If facilities are available for weighing the coarse aggregate in water similar to the arrangement described in California Test 223, the volume of coarse aggregate can be obtained without surface drying the material. The bulk specific gravity (SSD) of the coarse aggregate must be known.

2. Attach a brass wire bale to the 4.75 mm sieve and determine its apparent tare mass while suspended in water.

3. Place the washed coarse aggregate in the sieve and determine its apparent mass to the nearest .01 kg while suspended in water. The sieve and the coarse aggregate must be entirely submerged, and the sieve should be at the same level as when the tare mass was determined.

4. Subtract the tare mass from the mass of the sieve containing coarse aggregate. The net mass will be the mass of coarse aggregate in the test sample while suspended in water.

5. Calculate the mass of the SSD aggregate in air by use of the following formula:

$$e = D \times G/(G-1) \qquad (5)$$

Where:

$e$ = SSD mass in kg of the coarse aggregate in wet sieved sample.

$D$ = submerged apparent mass in kg of coarse aggregate.

$G$ = bulk specific gravity (SSD) of the coarse aggregate.

6. Use the SSD calculated mass of coarse aggregate of the wet sieved sample formula (5), to calculate the mass of coarse aggregate in a cubic meter of concrete by use of the following formula:

$$W = e \times u/d \quad (6)$$

Where:

$W$ = mass in kg of coarse aggregate per cubic meter of concrete.

$e$ = SSD mass in kg of coarse aggregate in test sample as determined above.

$u$ = density in kg/m$^3$ of fresh concrete, as determined by California Test 518.

$d$ = mass in kg of sample of concrete from density measure.

7. Calculate the absolute volume of coarse aggregate per m$^3$ of concrete by use of the following formula:

$$V = W/(G \times 999.5) \quad (7)$$

Where:

$V$ = absolute volume in m$^3$ of coarse aggregate per m$^3$ of concrete.

$W$ = mass in kg of coarse aggregate per m$^3$ of concrete.

$G$ = bulk specific gravity of the coarse aggregate.

## G. NOTES

When wet screening the fresh concrete, do not overload the sieve. Use small amounts and repeat the operation until the washed aggregate is free from sand and cement. Change wash water as necessary to facilitate washing of coarse aggregate.

Before weighing the total amount of clean, washed aggregate in the approximate method, drain off all free water.

## H. SAFETY AND HEALTH

Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

**REFERENCES:**
California Tests 206, 223 and 518

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